R645-301-200 SOILS SECTION

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R645-301-220. ENVIRONMENTAL DESCRIPTION

The soils in the permit area are developed primarily from sandstone and shale parent materials of the North Horn, Upper Price River, Castlegate, and Blackhawk formations. Along the highest parts of the ridge of East Mountain, a few spots have soils developed from the Flagstaff Limestone. The regolith consists of both residual and colluvial materials, yielding soils that range from shallow to very deep. Most soils are well drained with potentially rapid runoff due to the steepness of most of the slopes.

The range of elevations (from 8,100~~7,600~~ to over 10,700 feet) and steep slopes with varying aspects are the cause of large soil temperature and moisture differences. The soils on lower elevation / south facing slopes are hot and dry, and those at higher elevations and north facing slopes are cool and moist. Soil temperature regimes include cryic (cold) and frigid and the soil moisture regimes are udic (moist) and ustic (semiarid). The aspen and spruce-fir vegetation types are characteristic of the cryic/udic environment and the lower elevation mountain brush with some pinion-juniper is characteristic of the frigid/ustic environment.

Soils on sandstones are typically cobbly or stony with textures of loamy sand, sandy loam, or loam. Rock outcrops are common, expecially in areas of the Castlegate Sandstone. These soils are most common along the east side of the permit area.

Most of the area at higher elevations have clayey soils derived from the North Horn Formation. Textures of clay loam, silty clay loam, and clay are common. The subsoils often have a higher clay content than those of the surface soils. They have higher water holding capacities and are prone to slope failures. These clayey soils typically have high self-healing capabilities, and tend

to buffer the effects of tension cracks created in the soil zone that are occasionally formed by subsidence.

Topsoil development is most pronounced in areas with aspen vegetation types. It is commonly 10 to 20 inches thick in these areas, and has relatively high organic matter and nutrient contents. On the steep, north-facing slopes that support spruce-fir type forests, topsoil thicknesses may vary from three to ten inches.

Major soil limitations in the lease area include high soil erosion potentials, slope instability, cold temperatures and a short growing season, stoniness, and some droughty soils on the lower elevation /south facing slopes.

R645-301-221. PRIME FARMLAND INVESTIGATION

In the Environmental Assessment for the Mill Fork Lease Tract, LBA #11, prepared by the U.S.D.A. Forest Service (6/97), Chapter 1, Section G, states:

"There are no prime farmlands, rangelands, or alluvial valley floors within the proposed lease area. Leasing of the tract should not result in significant impacts to paleontological resources; threatened or endangered plant or animal species. Protection of these resources is provided under the lease stipulations and Federal and State laws and regulations."

Energy West has conducted numerous reconnaissance surveys of the Mill Fork permit area, consulted existing soils surveys and aerial photography, and concludes that there is no Prime Farmland or cropland within the permit area. This conclusion is based on the steep and rugged character of the terrain over the entire permit area. Historically, the permit area has been used only for cattle and sheep grazing.

R645-301-222. SOIL SURVEY

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. ~~Prior to any surface disturbance, Energy West will secure all necessary permits. Planning for surface disturbances to include mine facilities in the Mill Fork area is in the early infancy stage at present. Details for location, area, and design have not yet been worked out.~~ As these details become more definite, the applicable governmental agencies will be notified and the permitting process will be initiated. As part of this permitting process, a complete soil survey of each and every mining and reclamation operation within the Mill Fork area will be detailed in this section. However, the Mill Fork area has been mapped as part of a Soil Survey conducted by the Manti Division, Manti-LaSal National Forest.

R645-301-222.100. A Map Delineating Different Soils

Map MFS 1834B shows the areal distribution of the different soil types in the Mill Fork Permit area. Refer to the Map Section for review of these areas.(D. Larsen, in progress).

R645-301-222.300. Soil Description

The soil units shown on the map MFS 1834B are described below.

Map Unit Number	Soil Units	Percent (%)
8	***Greyback Family - Echard - Cryorthents Complex***	
	1. Greyback family soils	40
	2. Echard family soils	20
	3. Cryorthents	20
	Inclusions:	
	1. Clayey soils with lower rock fragment content	20
20	***Strych - Pathead - Podo Families - Rubbleland Complex***	
	1. Strych family soils	30
	2. Pathead family soils	30
	3. Podo family soils	15
	4. Rubbleland	15
	Inclusions:	
	1. Rock outcrops	10
42	***Aquic Cryoborolls, Loamy - Skeletal, Mixed***	
	1. Aquic cryoborolls, loamy-skeletal, mixed, loam, 5 to 15% slopes	90
	Inclusions:	
	1. Typic Cryoborolls, loamy-skeletal, mixed, loam, 5 to 15% slopes	08
	2. Aquic Cryorthents, loamy-skeletal, mixed, loam, 30 to 30% slopes	02
81	***Bundo - Lucky Star - Scout Families Complex***	
	1. Typic Paleboralfs, loamy-skeletal, mixed, fine sandy loam, 40 to 70% slopes	70
	2. Boralfic Cryoborolls, loamy-shkeetal, mixed, loam, 30 to 60% slopes	20
	Inclusions:	

Map Unit Number	Soil Units	Percent (%)
	1. Pachic Cryoborolls, fine-loamy, mixed, loam, 30 to 60% slopes	10
100	***Gralic - Behanin - Elwood Families Complex***	
	1. Typic Cryothents, loamy-skeletal, mixed (non-acid), cobbly fine sandy. loam, 50% slopes	40
	2. Pachic Cryoborolls, loamy-skeletal, mixed, loam, 30 to 60% slopes	25
	3. Argic Cryoborolls, loamy-skeletal, mixed, very stony loam, 40 to 70 %	20
	Inclusions:	
	1. Typic Cryoborolls, fine loamy, mixed	07
	2. Typic Cryorthents, fine loamy, mixed, calcareous, shallow, 40 to 60 % slopes	06
	3. Rock outcrops	02
107	***Curecanti - Elwood - Duschene Families Complex***	
	1. Loamy-skeletal, mixed typic Argiborolls	35
	2. Loamy-skeletal, mixed typic Cryoborolls	25
	3. Loamy-skeletal, mixed typic Cryoboralfs	25
	Inclusions:	
	1. Contrasting inclusions of rock outcrops and shallow soils	15
109	***Elwood Family Soils***	
	1. Loamy, skeletal, mixed Argic Cryoborolls	85
	Inclusions:	
	1. Contrasting inclusions of soils with lower content of rock fragment	15
301	***Greyback - Loamy, Mixed (non-acidic) Lithic Cryrothents - Bacholor Families Complex***	
	1. Typic Cryoborolls, loamy-skeletal, mixed, cobbly loam, 30 to 50% slopes	35

Map Unit Number	Soil Units	Percent (%)
	2. Lithic Cryorthents, loamy-mixed (non-acid), stony, fine, sandy loam, 30 to 80 % slopes	25
	3. Typic Cryorthents, fine-loamy, mixed (calcareous), loam, 30 to 50 % slopes	20
	Inclusions:	
	1. Rock outcrops	05
	2. Typic Cryorthents, fine-loamy, mixed (calareous), bouldery, loam 5 to 30 % slopes	05
	3. Argic Pachic Cryoborolls, fine-loamy, mixed, loam, 5 to 15 % slopes	05
401	***Adel - Merino Families Complex***	
	1. Pachic Cryoborolls, fine-loamy, mixed, loam, 30 to 60 % slopes	40
	2. Lithic Cryoborolls, loamy-skeletal, mixed (non-acid), cobbly, loam, 8 to 60 % slopes	23
	3. Typic Cryorthents, loamy, mixed (non-acid), shallow, cobbly, loam, 8 to 30 % slopes	20
	Inclusions:	
	1. Pachic Cryoborolls, fine-loamy, mixed, cobble, clay-loam, moderately deep, 8 to 30 % slopes	15
	2. Rock outcrops	02
560	***Clayburn - Broad Canyon Family Complex***	
	1. Argic Pachic Cryoborolls, fine loamy, mixed, loam, 5 to 40 % slopes	45
	2. Typic Cryoborolls, loamy-skeletal, mixed, cobbly loam, 30 to 50 % slopes	40
	Inclusions:	
	1. Typic Cryoborolls, fine-loamy, mixed, shallow	05
	2. Boralfic Cryoborolls, loamy-skeletal, mixed, loam, 30 to 60 % slopes	05

Map Unit Number	Soil Units	Percent (%)
	3. Pachic Cryoborolls, coarse-loamy, over sandy or sandy-skeletal, mixed, fine sandy loam, 30 to 60 % slopes	05
561	***Claybyrn - Faim - Behanin Families Comples***	
	1. Argic Pachic Cryoborolls, fine-loamy, mixed, loam, 5 to 20 % slopes	55
	2. Argic Pachic Cryogorolls, fine, montmorillonitic, loam, 5 to 20 % slopes	20
	3. Pachic Cryoborolls, loamy-skeletal mixed, loam, 10 to 30 % slopes	15
	Inclusions:	
	1. Lithic Cryoborolls, loamy-skeletal, mixed	09
	2. Rock outcrop	01
711	***Bundo - Lucky Star - Adel Families Complex***	
	1. Typic Paleboralfs, loamy-skeletal, mixed, loam, 40 to 70 % slopes	50
	2. Boralific Cryoborolls, loamy-skeletal, mixed loam, 30 to 60 % slopes	20
	3. Pachic Cryoborolls, fine-loamy, mixed, loam, 30 to 60 % slopes	20
	Inclusions:	
	1. Typic Cryorthents, loamy, mixed (non-acid), shallow, loam, 30 to 60 % slopes	10
820	***Lucky Star - Bundo - Adel Families Complex***	
	1. Boralfic Cryoborolls, loamy-skeletal, mixed, loam, 30 to 60 % slopes	55
	2. Typic Paleboralfs, loamy-skeletal, mixed, fine sandy loam, 40 to 70 % slopes	20
	3. Pachic Cryoborolls, fine-loamy, mixed, loam, 30 to 60 % slopes	20
	Inclusions:	
	1. Typic Cryorthents, loamy, mixed (non-acid), shallow	05

R645-301-230. OPERATION PLAN

All mining activities associated with the Mill Fork permit area will be through underground mining operations. Mine plan layouts (Hiawatha Seam) depicted in R645-301-500 Engineering Section, indicate potential portal breakouts located in Crandall Canyon, (Section 5, Township 16 South Range 7th East SLB&M), within a 2.41 acre right-of-way easement acquired from Andalex Resources/Intermountain Power Agency . The location of the portal breakouts are considered preliminary at this point and will be evaluated and designed based upon future surface coal exploration programs and mine plan considerations. Prior to any surface disturbance, Energy West will secure all necessary permits.